# Electromagnetism Laboratory

## Prof. Luca Gavioli

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The course aims to

- Develop experimental skills in laboratory work, implementing and strengthening the students' theoretical knowledge through a comparison against the experimental data.

- Acquire IT skills in data analysis.

- Accustom students to presenting the results of experiences through reports or presentations.

- Teach the ability to independently manage an experimental research project.

- Teach students how to identify and measure the main electromagnetic quantities and understand the phenomena connected to them.

At the end of the course, students will be able to:

* prepare the setup of instruments following instructions on an experimental sheet;
* collect measurements, including with appropriate dedicated software;
* analyse and graphically represent data, including with the use of calculation software, graphical representation and word processing;
* evaluate uncertainties about the measures carried out using the error theory;
* draw up a report of the laboratory experience carried out, in which the salient physical concepts, experimental procedure, results obtained, and a comparison with the expected results are clearly presented;
* discuss and verbally motivate what is presented in the laboratory report.

***COURSE CONTENT***

Introduction:

currents, voltage and resistance, Ohm's law, ideal current generators and voltage, series and parallel circuits, Kirchhoff's laws, Thevenin and Norton theorem, oscilloscope, alternating currents.

CHARGES AND CURRENTS

1) Electrostatic balance and Coulomb's law.

2) Continuous current circuits (series and parallel circuits, Ohm's law, the law of nodes and links, internal generator impedance).

3) Verification of the second law of Ohm.

4) Charge and discharge of a capacitor (RC-CR DC).

MAGNETIC FIELDS

5) Magnetic field (measurements of fields produced by wire, coils and terrestrial field).

INTERACTION OF MAGNETIC FIELD WITH CHARGES AND CURRENTS

6) Electrodynamic balance and Lorentz force.

7) Charge-to-mass ratio of the electron.

ELECTROMAGNETIC INDUCTION

8) Faraday's law.

***READING LIST***

D.J. Griffiths, *Introduction to Electrodynamics,* Prentice-Hall.

Taylor, *Introduzione all’analisi degli errori,* Zanichelli, Bologna, 1986.

FOR FURTHER READING:

L. De Salvo – G. Picchiotti, *Laboratorio di Ottica e Elettromagnetismo,* Cartolibreria Snoopy, Via Bligny n. 27, 25133 Brescia, 2006.

***TEACHING METHOD***

The course is divided into two sections. The first involves lectures conducted using cooperative learning activities. Students are asked to independently study successive parts of the theoretical notions, which are then discussed collegially between students and lecturers. Students are divided into small groups in which the problems encountered during their studies are addressed and a few selected questions discussed collectively. The roles for presenting and discussing content are rotated from time to time.

In the second unit, the groups (normally three students) carry out the proposed experiences and rework the data that emerges. The lecturers' job is to address and compare the problems that emerge or the results obtained, paying close attention to developing the students' ability to solve problems independently. In addition, the lecturers direct the group in writing reports on their laboratory experiences.

Attendance is compulsory, and it is not possible to take the exam without having carried out the group activities.

***ASSESSMENT METHOD AND CRITERIA***

Students will be marked on the basis of the following elements: presentation and discussion of lab reports; demonstrated commitment; and quality of work carried out during lab sessions, ability to use acquired knowledge to answer complex questions.

The table below provides a summary of the marking parameters, and will be used as the basis for discussion of the final mark.

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| --- | --- | --- | --- | --- |
| **LEVEL**  **ACHIEVED** | **LIMITED** | **BASIC** | **AVERAGE** | **EXCELLENT** |
| KNOWS HOW TO RESTATE THE PHASES OF EXPERIMENTS | Knows how to understand the phases of the experiments, only if supported by the teacher, but finds it difficult to restate the phases. | Understands and restates the phases of the experiments. | Carries out experiments independently, effectively explaining the findings. | Knows how to explain the experiments with the propriety of language and effectiveness, adding personal observations. |
| LEARNS HOW TO DRAFT A SCIENTIFIC REPORT | Knows how to draft a scientific report only if constantly assisted by the teacher. | Knows how to draft a scientific report independently. | Drafts and develops complex scientific reports. | Prepares complex and structured scientific reports, adding personal observations. |
| KNOWS HOW TO FULFIL HIS/HER ROLE IN GROUP WORK. | Does not fulfil his/her role. Has trouble in completing the work, even if constantly assisted. | Fulfils his/her role. Completes the work, against precise instructions. | Fulfils his/her role. Completes the work assigned and contributes spontaneously to the group project. Provides help to other students. | Fulfils his/her role effectively. Completes the work assigned and contributes with personal inputs to the group project. Provides help to other students. |

***NOTES AND PREREQUISITES***

Attendance is compulsory, and it is not possible to take the exam without having completed the group activities. To meet the needs of any working students, they may also conduct the activities outside the established lecture hours and help is offered for any catch-up necessary. Lecturers may receive students outside the scheduled hours according to availability and following prior arrangement either directly or via email.

The following is required:

a minimum basic level of computer management skill (students should possess at least a basic knowledge of word processing programmes and spreadsheets);

knowledge of the mathematical concepts of derivation and integration;

ideally, knowledge of the basic notions of electromagnetism.

*Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.*